

THE EFFECTS OF THE UNCERTAINTY OF DEPARTURES ON MULTI-CENTER TRAFFIC MANAGEMENT ADVISOR SCHEDULING

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Abstract

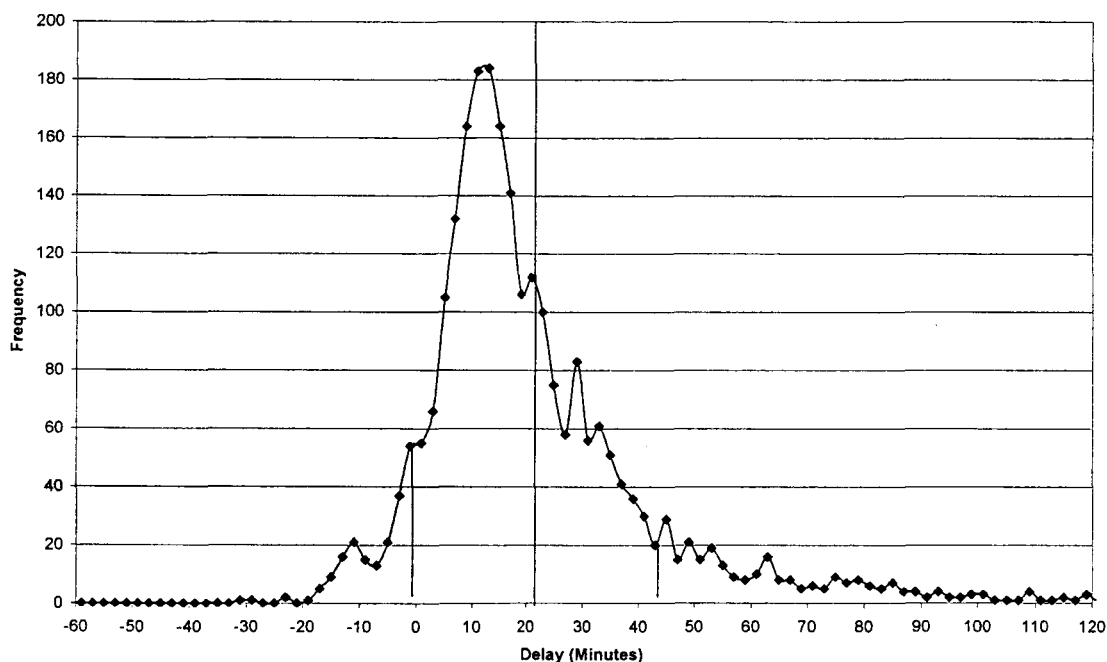
The Multi-center Traffic Management Advisor (McTMA) provides a platform for regional or national traffic flow management, by allowing long-range cooperative time-based metering to constrained resources, such as airports or air traffic control center boundaries. Part of the demand for resources is made up of proposed departures, whose actual departure time is difficult to predict. For this reason, McTMA does not schedule the departures in advance, but rather relies on traffic managers to input their requested departure time. Because this happens only a short while before the aircraft's actual departure, McTMA is unable to accurately predict the amount of delay airborne aircraft will need to take in order to accommodate the departures. The proportion of demand which is made up by such proposed departures increases as the horizon over which metering occurs gets larger.

This study provides an initial analysis of the severity of this problem in a 400-500 nautical mile metering horizon and discusses potential solutions to accommodate these departures. The challenge is to smoothly incorporate departures with the airborne stream while not excessively delaying the departures.¹ In particular, three solutions are reviewed: (1) scheduling the departures at their proposed departure time; (2) not scheduling the departures in advance; and (3) scheduling the departures at some time in the future based on an estimated error in their proposed time. The first solution is to have McTMA to automatically schedule the departures at their proposed departure times. Since the proposed departure times are indicated in their flight times in advance, this method is the simplest, but studies have shown that these proposed times are often incorrect.² The second option is the current practice, which avoids these inaccuracies by only scheduling aircraft when a confirmed prediction of departure time is obtained from the tower of the departure airport. Lastly, McTMA can schedule the departures at a predicted departure time based on statistical data of past departure time performance. It has been found that departures usually have a wheels-up time after their indicated proposed departure time, as shown in Figure 1. Hence, the departures were scheduled at a time in the future based on the mean error in proposed departure times for their airport.

Results were generated from Monte Carlo simulations with several datasets involving both live and simulated air traffic. The metric used to evaluate each alternative was to examine the differences between actual airborne aircraft delays versus airborne delays resulting from each option. Departure times used to calculate the actual airborne aircraft delays were based on fitting the errors in proposed departure times to a normal distribution. Results indicate that over this

400-500 nautical mile metering horizon, the effects of the uncertainty in actual departure times are not as severe as anticipated. This suggests that extending McTMA beyond its current limits may be feasible, which will ultimately be needed to support traffic flow management over a longer range. Furthermore, when comparing the three methods for this current metering horizon, not scheduling the departures far in advance was the most effective. The limit as to how much the metering horizon can be expanded with this current practice before having a major effect on airborne traffic is a topic for further research.

ZOB 12/26/2003 17 Hours - Average Delay 21+/-22 Minutes 2498 Aircraft



Kille, R: Summary of the July 1999 Internal Departure Delay Investigation for ZDV Along with New Departure Delay Data From ZOB, ZID, ZFW and ZDV. Computer Sciences Corporation, May 2004.

Figure 1. Departure time performance.

¹ Farley, T., J. Foster, T. Hoang, and K. Lee, "A time-based approach to metering arrival traffic to Philadelphia," First AIAA Aircraft Technology, Integration, and Operations Forum, Los Angeles, California, October 2001.

² Kille, R: Summary of the July 1999 Internal Departure Delay Investigation for ZDV Along with New Departure Delay Data From ZOB, ZID, ZFW and ZDV. Computer Sciences Corporation, May 2004.